

IAP11 Rec'd PCT/PTO 18 JUL 2006

CONTENTS OF ART 34 AMEND

- (1) The title of the invention described in line 2, page 1 of the description should be amended to be read as "DISCHARGE LAMP, METHOD FOR MANUFACTURING THE DISCHARGE LAMP ELECTRODE, AND LIGHTING SYSTEM".
- (2) The entire paragraph (0014) described in page 2 of the DESCRIPTION (Translator's note: page 4 thereof in English text) should be amended to be read as "In order to SOLVE THE ABOVE-MENTIONED PROBLEMs, A DISCHARGE LAMP RELATED TO THE INVENTION HAS an electrode including a heater constituted of a coil portion and a first lead wire portion and a second lead wire portion that respectively connect the coil portion through a rear end of the coil portion, the heater having an electron emission material applied thereto, and scattering-prevention member, which is a cylindrical sleeve whose both ends are open, for covering surrounding of the coil portion, the both open ends respectively facing the forward end and the rear end of the coil portion, and a connection-reinforcing member that has a first connection member for connecting the first lead wire portion, and a second connection member for connecting the second lead wire portion, while the first and second connection members integrated with each other by means of a coupling portion are separated from each other by cutting the coupling portion, each of the first and second connection members being composed of L-shaped plate member, wherein the connection-reinforcing member is supported by any one of the first and second connection members, wherein in the electrode, the first lead wire portion is connected to a first lead-in wire and the

second lead wire portion is connected to the second lead-in wire, said first and second lead-in wires being provided on two opposed ends of a glass tube in which a gas containing a light-emitting material is enclosed and to an interior of which 5 fluorescent substance is coated, and wherein the coil portion is arranged vertically along a tube axis of the glass tube."

(3) The entire paragraph (0017) described in page 3 of the DESCRIPTION (Translator's note: page 5 thereof in English text) 10 should be amended to be read as "Further, according to the discharge lamp relative to the invention, cylindrical scattering-prevention member whose both ends are open that respectively face the forward end and the rear end of the coil portion, covers surrounding of the coil portion."

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(4) The entire paragraph (0018) described in page 3 of the DESCRIPTION (Translator's note: page 6 thereof in English text) should be amended to be read as "Thus, according to a 20 discharge-lamp related to the present invention, a scattering-prevention member arranged around the coil portion inhibits the ions from colliding with a side of the coil portion and also inhibits the electron emission material from being evaporated."

(5) The words, "A discharge lamp electrode related to the 25 present invention" described in line 1 of the paragraph (0105), page 15 of the DESCRIPTION should be amended to be read as "Further, a discharge lamp related to the present invention".

(6) The words, "Further, the first and second connection 30 members that connect the lead wire portion connected with the

coil portion with the lead-in wire provided on the glass tube  
are made of L-shape plate members, thereby enhancing their  
strength as the reinforcing members." should be added after the  
last line of the paragraph (0105), page 15 of the DESCRIPTION

5 (Translator's note: page 31 thereof in English text).

(7) The words, "said scattering-prevention member having  
openings in surfaces that respectively face" claimed in claim 1  
described page 17 (Translator's note: page 33 in art 19

10 Amendment) should be amended to be read as "said both open ends  
respectively facing". The words, "with the first lead-in  
wire" should be deleted from the words, "a first connection  
member for connecting the first lead wire portion with the  
first lead-in wire" claimed in claim 1 described page 17

15 (Translator's note: page 33 in art 19 Amendment) and the words,  
"with the second lead-in wire" should be deleted from the  
words, "a second connection member for connecting the second  
lead wire portion with the second lead-in wire" claimed in

claim 1 described page 17 (Translator's note: page 33 in art 19

20 Amendment). The words, "each of the first and second  
connection members being composed of L-shaped plate member,"  
should be added after the words, "the first and second  
connection members integrated with each other by means of a  
coupling portion are separated from each other by cutting the  
25 coupling portion" claimed in claim 1 described page 17  
(Translator's note: page 33 in art 19 Amendment).

## **DESCRIPTION**

### **DISCHARGE LAMP, METHOD FOR MANUFACTURING THE DISCHARGE LAMP ELECTRODE, AND LIGHTING SYSTEM**

#### **TECHNICAL FIELD**

(0001)

The present invention relates to a discharge lamp of hot-cathode type, a discharge-lamp electrode, a method for manufacturing the discharge-lamp electrode, and a lighting system. More specifically, it relates to employment of an electrode having a coil portion along a tube axis of a glass tube, thereby reducing a diameter of the glass tube and prolonging a service life of the electrode.

#### **BACKGROUND ART**

(0002)

Conventionally, a discharge lamp has been used that employs a fluorescent substance as a light source. Among the discharge lamps, a discharge lamp of hot-cathode type has been used as a backlight of a liquid crystal display (LCD) as well as for lighting because discharge lamp of this type has a high level of luminous efficiency and hence a high degree of luminance.

(0003)

The discharge lamp of hot-cathode type has a configuration in which its glass tube is equipped with an electrode at each of its two opposed ends, a rare gas such as argon and mercury are enclosed in an internal space of the

Moreover, since the heater extends perpendicularly to the tube axis, a problem has arisen that a diameter of the tube cannot be reduced.

(0012)

Further, although a discharge lamp of cold-cathode type, which can be reduced in tube diameter, has a longer service life, it suffers from a large drop in voltage of a cathode, thus resulting in poor efficiency.

(0013)

The present invention solves these problems and has an object to provide a discharge lamp with a short tube diameter, that is of a higher level of efficiency and longer in terms of service life, an electrode for use in the discharge lamp, a method for manufacturing the discharge lamp electrode, and a lighting system.

#### **DISCLOSURE OF THE INVENTION**

(0014)

In order to SOLVE THE ABOVE-MENTIONED PROBLEMs, A DISCHARGE LAMP RELATED TO THE INVENTION HAS an electrode including a heater constituted of a coil portion and a first lead wire portion and a second lead wire portion that respectively connect the coil portion through a rear end of the coil portion, the heater having an electron emission material applied thereto, and scattering-prevention member, which is a cylindrical sleeve whose both ends are open, for covering surrounding of the coil portion, the both open ends respectively facing the forward end and the rear end of the coil portion, and a connection-reinforcing member that has a first connection member for connecting the first lead wire

portion, and a second connection member for connecting the second lead wire portion, while the first and second connection members integrated with each other by means of a coupling portion are separated from each other by cutting the coupling portion, each of the first and second connection members being composed of L-shaped plate member, wherein the connection-reinforcing member is supported by any one of the first and second connection members, wherein in the electrode, the first lead wire portion is connected to a first lead-in wire and the second lead wire portion is connected to the second lead-in wire, the first and second lead-in wires being provided on two opposed ends of a glass tube in which a gas containing a light-emitting material is enclosed and to an interior of which fluorescent substance is coated, and wherein the coil portion is arranged vertically along a tube axis of the glass tube.

(0015)

According to a discharge lamp related to the present invention, by energizing the electrode, an electron emission material is heated to emit electrons, and also by applying a voltage between the two electrodes at a high frequency, arc discharge occurs. The electrons thus accelerated collide with a light-emitting material so as to excite it, and in turn the light-emitting material emits, for example, ultraviolet light. Then, this ultraviolet light collides with a fluorescent substance so as to be converted into visible light, thereby rendering the discharge lamp luminiferous.

(0016)

Although ions generated during discharge generally collide with the electrodes and thus contribute to scattering of the electron emission material, the ions specifically

collide mainly with a forward end of a coil portion of each of the electrodes because the coil portion is arranged vertically along a tube axis of a glass tube. Therefore, the electron emission material is inhibited from being scattered along a major part of the coil portion.

(0017)

Further, according to the discharge lamp relative to the invention, cylindrical scattering-prevention member whose both ends are open that respectively face the forward end and the rear end of the coil portion, covers surrounding of the coil portion.

(0018)

Thus, according to a discharge lamp related to the present invention, a scattering-prevention member arranged around the coil portion inhibits the ions from colliding with a side of the coil portion and also inhibits the electron emission material from being evaporated.

(0019)

A method for manufacturing a discharge lamp electrode related to the invention has a winding step of winding a wire to form a heater, the heater having a coil portion and a first lead wire portion and a second lead wire portion that extend respectively from a rear end of the coil portion, a connection-reinforcing-member-welding step of welding the first lead wire portion of the heater to a first connection member of a connection-reinforcing member, and of welding the second lead wire portion of the heater to a second connection member of the connection-reinforcing member, the connection-reinforcing member including the first and second connection members with them being integrated with each other by means of a coupling

portion, an application step of applying an electron emission material to the heater in a condition where the heater is held by the connection-reinforcing member, a lead-in portion welding step of welding a first lead-in wire to the first connection

present invention, ions generated during discharge collide mainly with a forward end of the coil portion, so that it is possible to inhibit ion sputtering along a major part of a side of the coil portion.

(0102)

Accordingly, the electron emission material is inhibited from being exhausted and thus can emit electrons over a long period. Further, since the present embodiment applies no tension on the heater by stretch, the heater can be inhibited from being disconnected. Therefore, a service life of the electrode can be prolonged. A prolonged service life of the electrode in turn prolongs a service life of the discharge lamp.

(0103)

Further, since the electrode is arranged vertically along the tube axis of the glass tube, a tube diameter of the glass tube can be reduced without reducing a length of the coil portion.

(0104)

Because the coil portion can be maintained for long enough to have a sufficient quantity of an electron emission material applied thereto, a reduced diameter of the glass tube makes it possible to enhance the luminance as well as prolong the length of service life.

(0105)

Further, a discharge lamp related to the present invention can further suppress ion sputtering by further arranging a scattering-prevention member around a coil portion. It is also possible to prevent an electron emission material that has evaporated from being scattered onto a tube surface or

a fluorescent substance and, further, to prevent the electron emission material from being exhausted. Accordingly, a discharge lamp using an electrode in which a scattering-prevention member is arranged around a coil portion can have a further prolonged service life. Further, the first and second connection members that connect the lead wire portion connected with the coil portion with the lead-in wire provided on the glass tube are made of L-shape plate members, thereby enhancing their strength as the reinforcing members.

(0106)

According to a method for manufacturing a discharge lamp electrode related to the present invention, for example, a step is performed in which an electron emission material is applied in a condition where a heater is supported by a connection-reinforcing member, so that the heater can be prevented from being deformed during manufacturing process. As a result, a yield is improved, and it is thus possible to manufacture inexpensively an electrode equipped with a heater in which a coil portion is arranged vertically along a tube axis of a glass tube.

(0107)

A lighting system related to the present invention can be equipped with the above-described discharge lamp, thereby having a reduced thickness and a prolonged service life.

#### **INDUSTRIAL APPLICABILITY**

(0108)

The present invention relates to a discharge lamp having a longer service life and a smaller tube diameter, and thus can be suitably applied as not only lighting equipment but

also a backlight for an LCD, etc., thereby contributing to an improvement in efficiency, prolonging a service life, and reducing a thickness of the LCD.

**CLAIMS**

1. (Amended) A discharge lamp comprising:  
an electrode including:

a heater constituted of a coil portion and a first lead wire portion and a second lead wire portion that respectively connect the coil portion through a rear end of the coil portion, the heater having an electron emission material applied thereto; and

scattering-prevention member, which is a cylindrical sleeve whose both ends are open, for covering surrounding of the coil portion, said both open ends respectively facing the forward end and the rear end of the coil portion; and

a connection-reinforcing member that has a first connection member for connecting the first lead wire portion, and a second connection member for connecting the second lead wire portion, while the first and second connection members integrated with each other by means of a coupling portion are separated from each other by cutting the coupling portion, each of the first and second connection members being composed of L-shaped plate member,

wherein the connection-reinforcing member is supported by any one of the first and second connection members;

wherein in the electrode, the first lead wire portion is connected to a first lead-in wire and the second lead wire portion is connected to the second lead-in wire, said first and second lead-in wires being provided on two opposed ends of a glass tube in which a gas containing a light-emitting material